

UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF 1,4,7,10-  
TETRAAZACYCLODODECANE (CYCLEN)  
COMPOUND FOR MOLECULAR STUDY PURPOSES.

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# TABLE OF CONTENTS

	Page
TITLE PAGE	
APPROVAL FORM	
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iii
LIST OF TABLE	v
LIST OF FIGURES	vi
LIST OF ABBREVIATIONS	vii
ABSTRACT	viii
 CHAPTER ONE (INTRODUCTION)	 1
1.1 Introduction of cyclen	1
1.2 The uses of 1,4,7,10-tetraazacyclododecane <u>1</u>	1
 CHAPTER TWO (LITERATURE REVIEW)	 4
2.1 Description of 1,4,7,10-tetra-azacyclododecane	4
2.2 Derivatives molecular compound comes from cyclen	6
2.3 Main Starting Material for cyclen synthesis	7
2.3.1 Diethylene Triamine	7
2.3.2 Diethanolamine	8
2.3.3 Triethylamine	9
2.4 Chemical Structure Related to the Synthesis Process	10
2.5 Richman-Atkins Cyclization Syntheses	11
 CHAPTER THREE (MATERIALS AND METHODS)	 12
3.1 Chemical and Materials Used	12
3.2 Instrumentations used	12
3.3 Synthesis of 1,4,7,10-tetraazacyclododecane (cyclen)	13
3.3.1 Synthesis of N-tosyldiethanolamine ditosylate (O-Tosyl) <u>6</u> from diethanolamine	14
3.3.2 Synthesis of tritosyldiethylenetriamine (N-Tosyl) <u>7</u> from diethylenetriamine	14
3.3.3 Coupling process of O-Tosyl and N-Tosyl	15
3.3.4 Detosylation or Deprotection of Tetratosylated cyclen <u>8</u>	15
3.3.5 Method of experiment	15
 CHAPTER FOUR (RESULTS)	 17
4.1 Thin Layer Chromatography (TLC) visualization	17
4.1.1 N-tosyldiethanolamine ditosylate (O-Tosyl) <u>6</u> from diethanolamine	17

## ABSTRACT

The main objective of this study is to synthesize a macrocyclic compound, 1,4,7,10-tetraazacyclododecane (cyclen). There are several techniques involved in order to synthesize this compound. Although in this experiment, only one method was chosen from several methods that are able to synthesize this compound. This experiment used Diethylenetriamine (DT) and Diethanolamine (DE) as starting material. The Diethylenetriamine and Diethanolamine are tosylated first by using para-toluene benzyl chloride or called Tosyl chloride (TsCl) with addition of triethylamine as a base and dichloromethane as a solvent. Diethylenetriamine preparation will yield N-Tosyl as a product and Diethanolamine will yield O-Tosyl as a product. Both of these products then coupled to yield the compound called cyclen that are very useful for the molecular study purposes. The already-made cyclen product from the factory made or commercially is available, but it is quite expensive, so that this experiment done to produce cyclen by ownself for the further purposes. Thin Layer Chromatography (TLC) is used for all of the chemical analysis and identification.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction of cyclen

1,4,7,10-tetra-azacyclododecane or cyclen is a macrocycle and the aza analogue of crown ethers. Derivatives of cyclen are larger cyclic polyamines but the repeating unit (ethyleneimine) is always the same. Like crown ethers, cyclen compounds are capable of selectively binding cations (Wikipedia, 2006).

Cyclen is an important macrocyclic tetraamine that has been used extensively in metal complexation (Bianchi, A. *et al.*, 1991) and as a synthetic precursor to related pendant-armed (Bernhardt, P. V. *et al.*, 1990) and bridged polydentate ligands (Micheloni, M. J. *et al.*, 1988), some of which have biomedical applications. The 12-membered cyclic tetramine cyclen (1,4,7,10-tetraazacyclododecane) **1** is a tetraaza macrocycle which is have a great practical importance.

### 1.2 The uses of 1,4,7,10-tetraazacyclododecane **1**

Complexes of some of cyclen based ligands have found applications as Magnetic Resonance Imaging (MRI) contrast agents, radiopharmaceuticals, luminescent probes, *in vivo* temperature probes, and *in vivo* Nuclear Magnetic Resonance (NMR) shift reagents. The analysis of single nucleotide polymorphisms (SNPs) is increasingly utilized in the